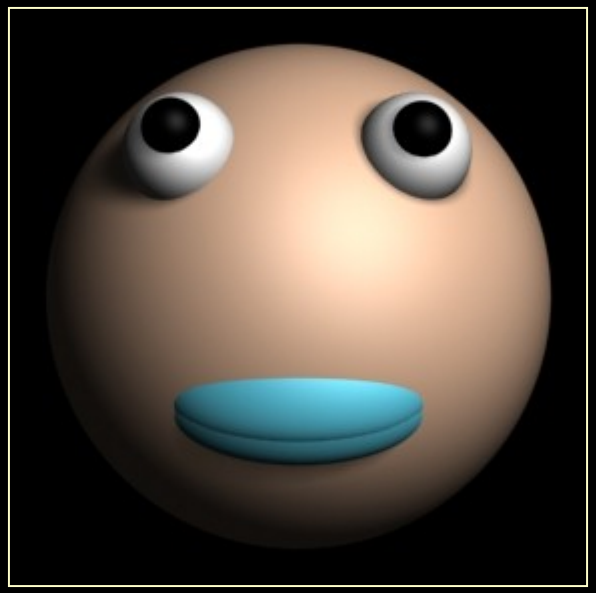
# A User Interface for Interactive Cinematic Shadow Design

Fabio Pellacini
Parag Tole
Donald P. Greenberg

*Program of Computer Graphics*
*Cornell University*

# Importance of Shadows



# *Shadow placement*

- Shadow placement by directly transforming lights/objects is hard
  - Shadows depend
    - on lights positions
    - on objects positions
    - in a very unintuitive manner
  - Need to determine which light/object pair cast the shadow

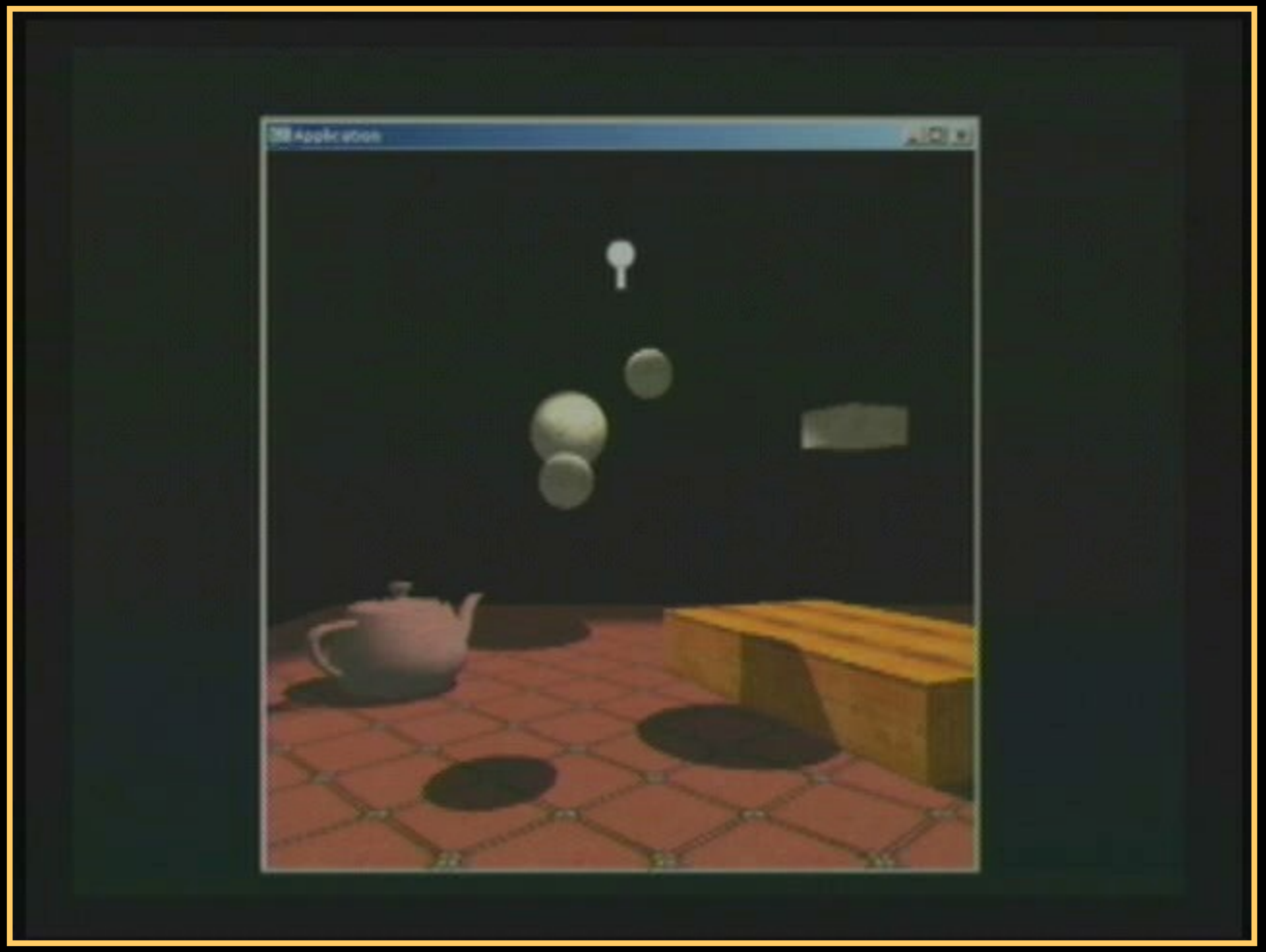
# *Previous work*

- Interactive systems
  - Shadow volume manipulation [Poul92]
    - Not as intuitive as manipulating shadows
- Optimization-based systems
  - What you paint is only approximately what you get

# Our approach

- Shadows are treated as first class entities
- Shadows transformations
  - displayed in realtime
    - quick user feedback
  - performed by a “click-and-drag” interface
    - mouse click: select shadow
    - mouse drag: move/scale/rotate shadow
      - on the surfaces of the scene
- All shadows are real!

# Our approach - VIDEO



# *Shadow movement example*

- Click on a shadow to select it
  - Light-object pair is selected

# Shadow movement example

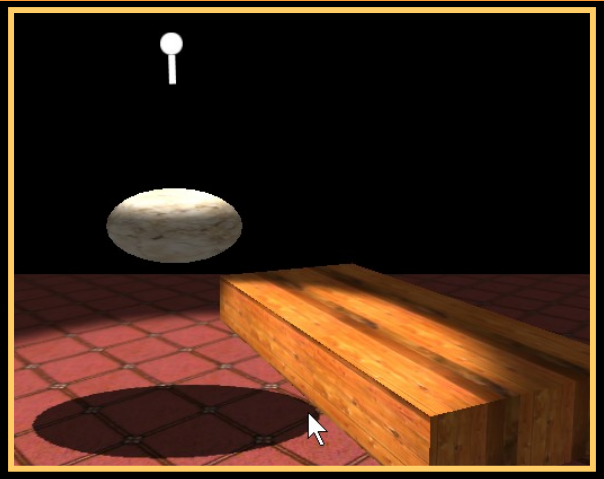
- Drag the shadow to a new position
  - Constrained on the surfaces of the scenes

# Shadow movement example

- System rotates the light around the object

# Light vs. Object transform

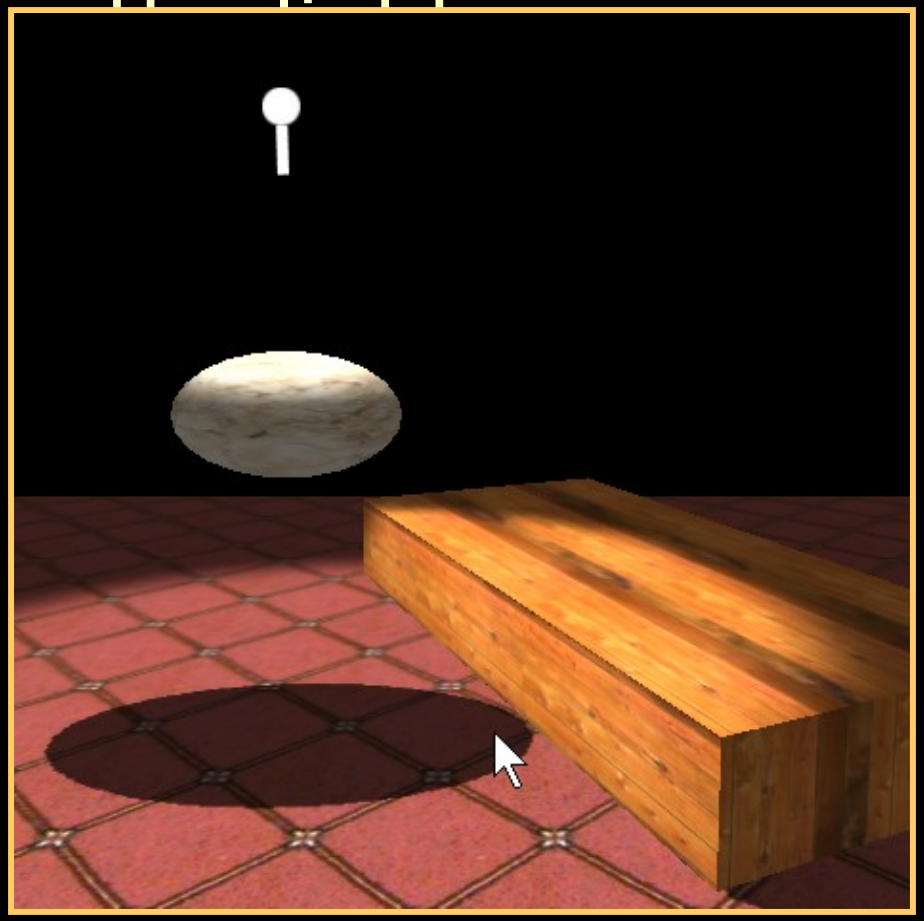
Move Light

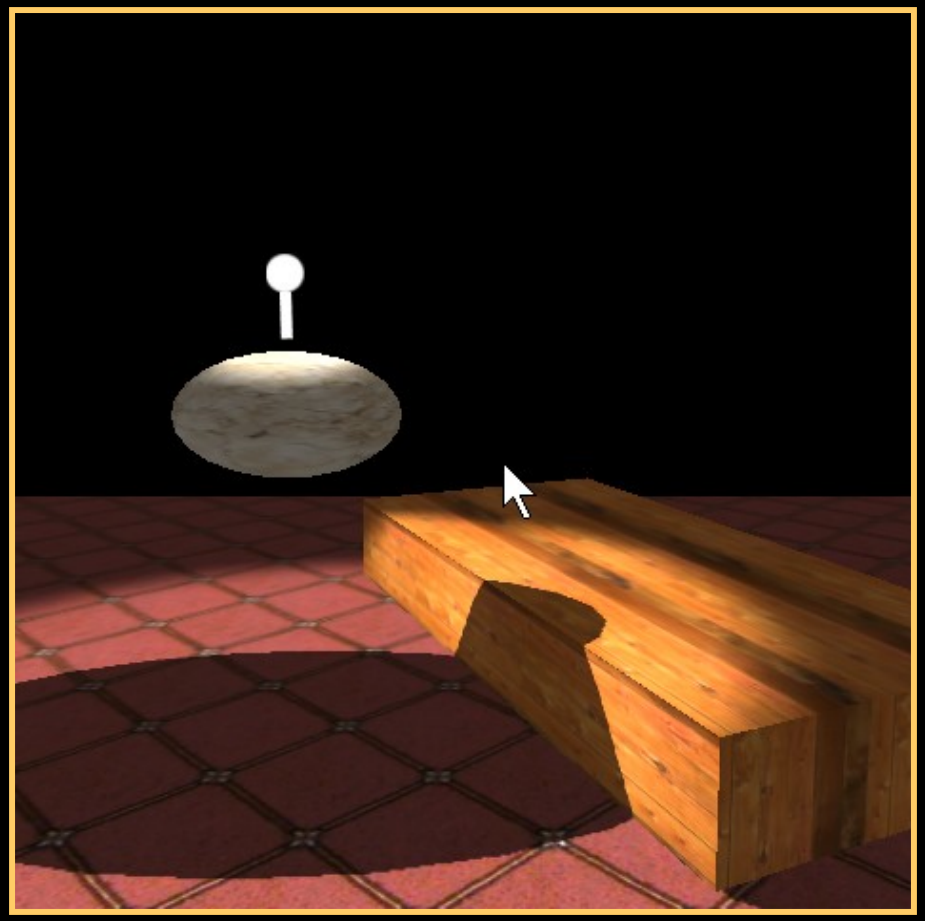


Move Object

# *Shadow scaling example*

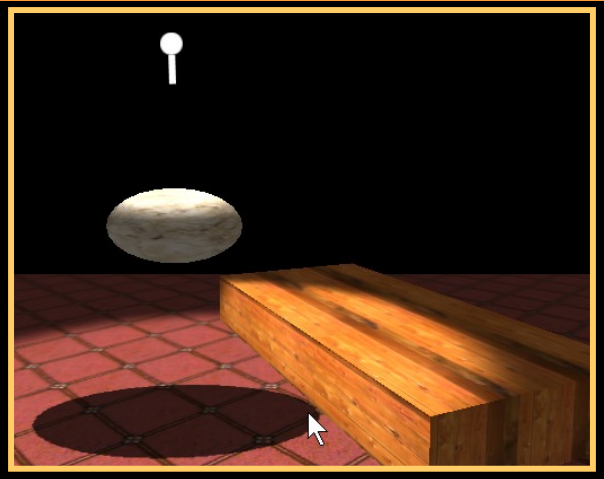
- System moves the light on the axis passing through the object center and



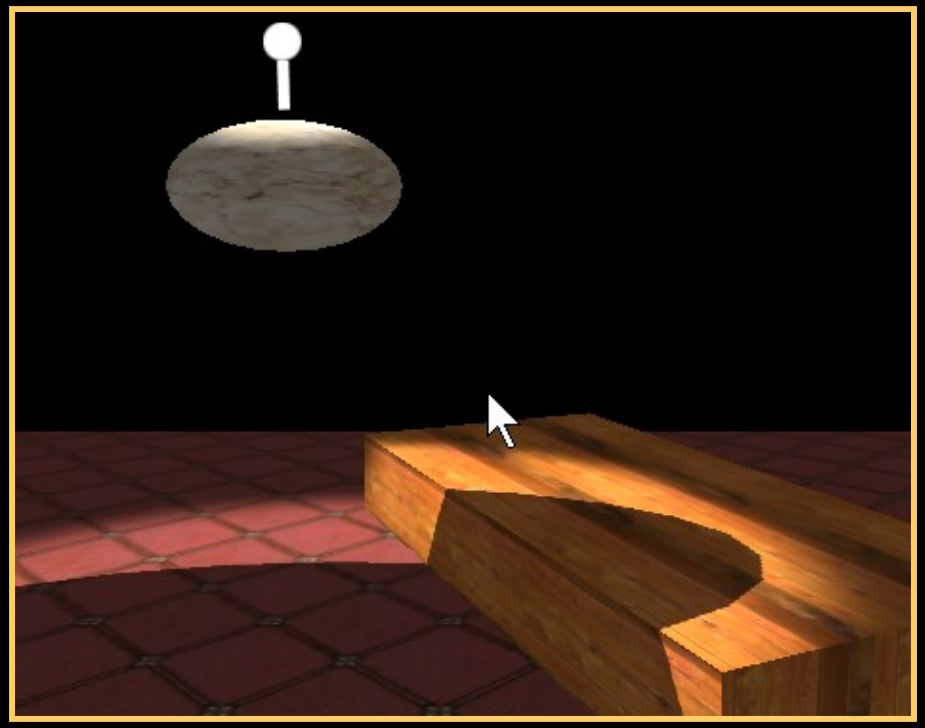


# *Light vs. Object transform*

Move Light

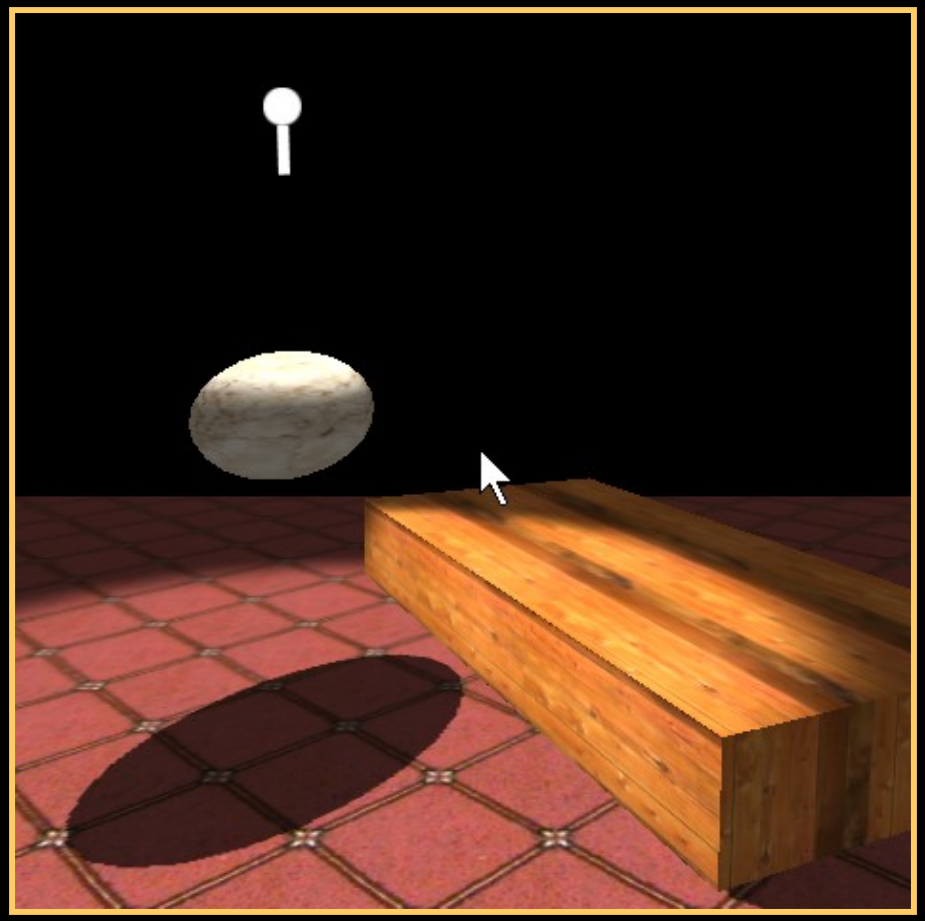


Move Object



# Shadow rotation example

- System rotates the object around the axis passing through  the object's center and the light



# Handling multiple lights/objects

- Automatically select light/object pair

# Handling multiple lights/objects

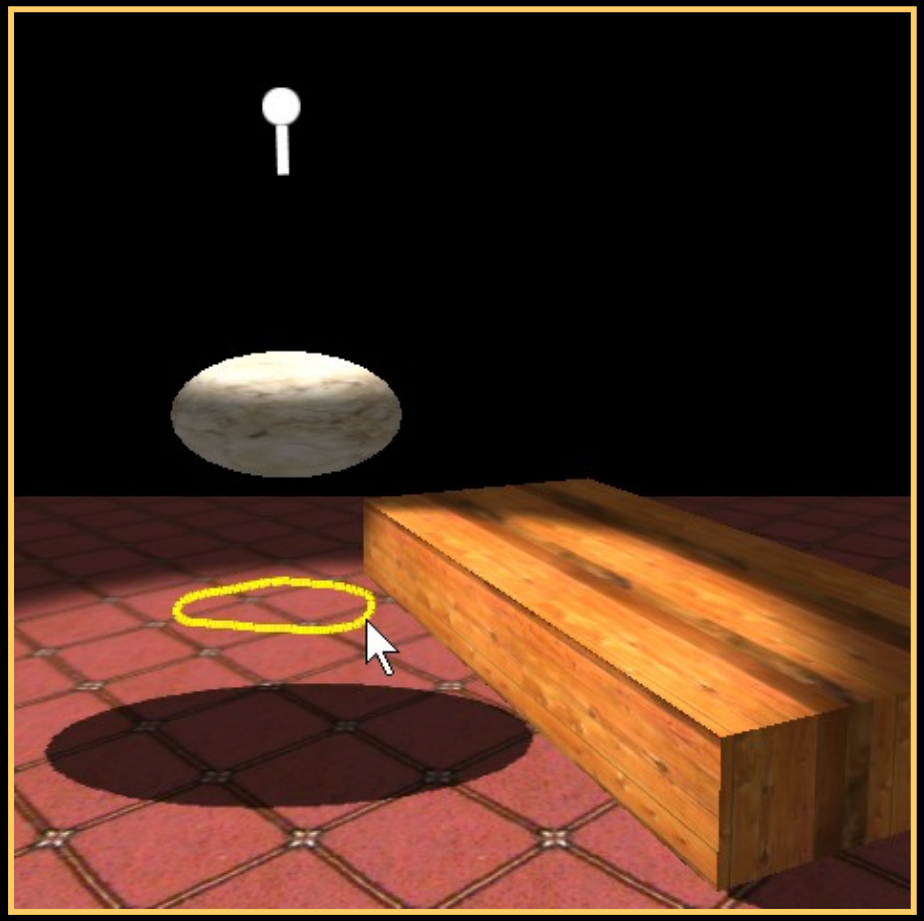
- Automatically select light/object pair

# Constraints

- Complex environments remain hard
  - Transforming a shadow affects other shadows
- Solution: apply constraints to mouse motion
  - Intuitive specification of constraints

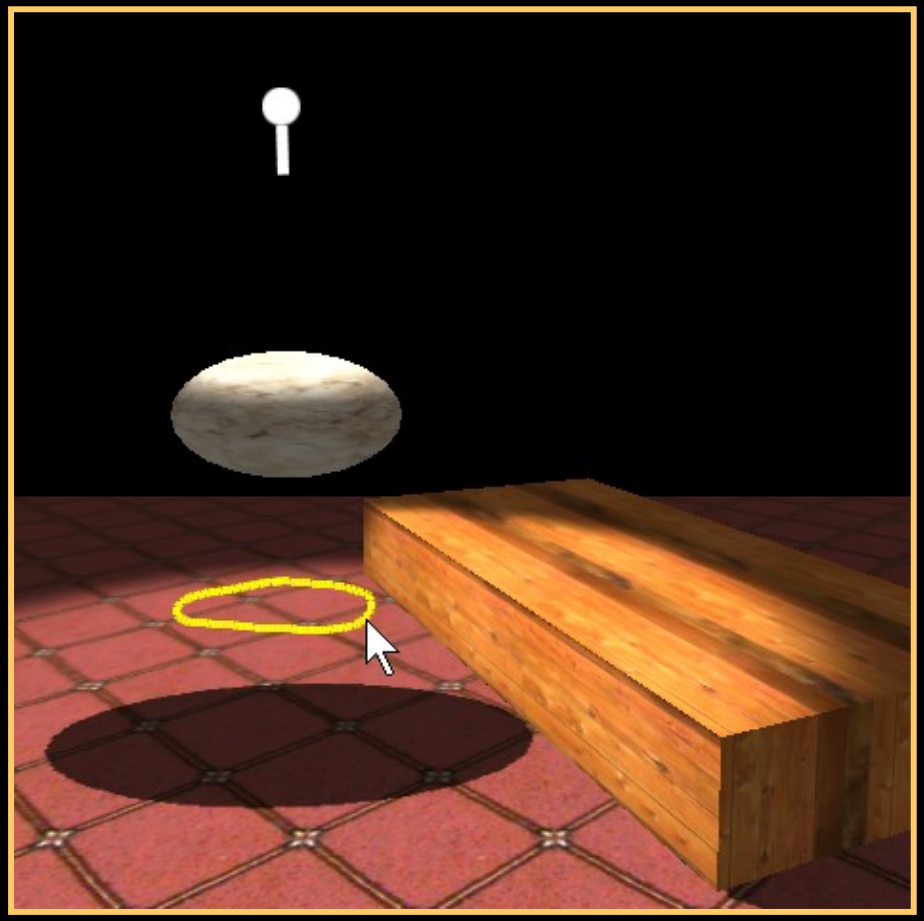
# Constraints

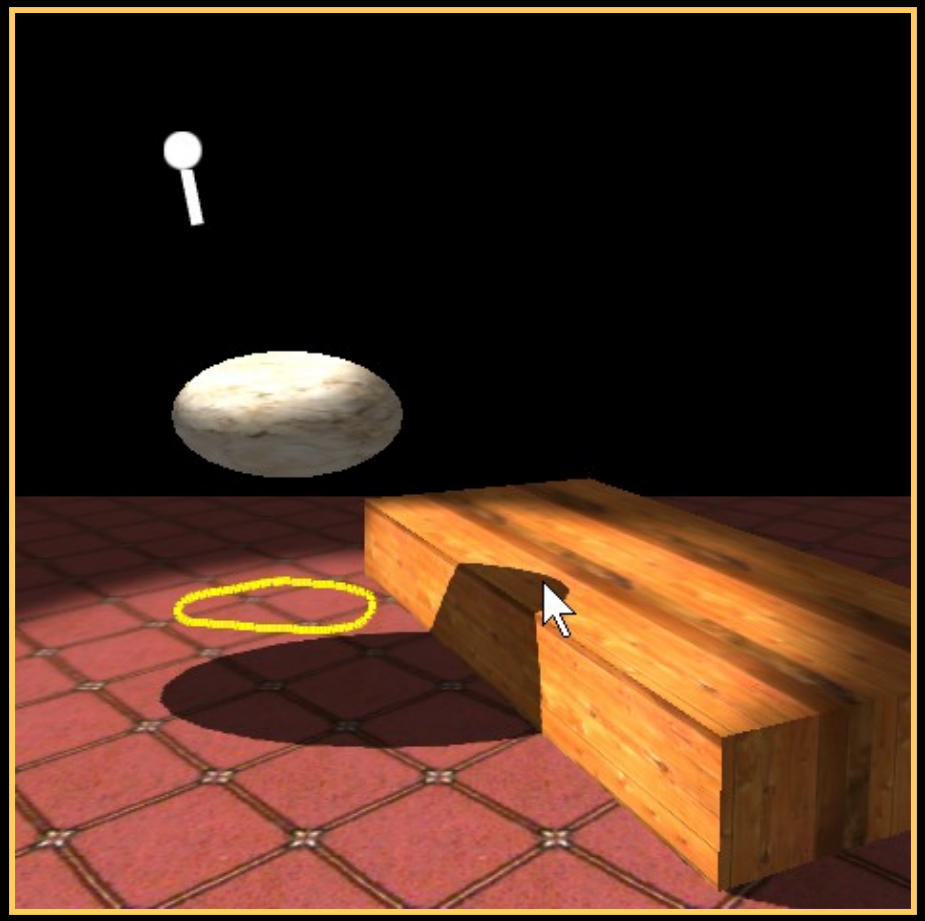
- Painting metaphor for constraint specification



# Constraints

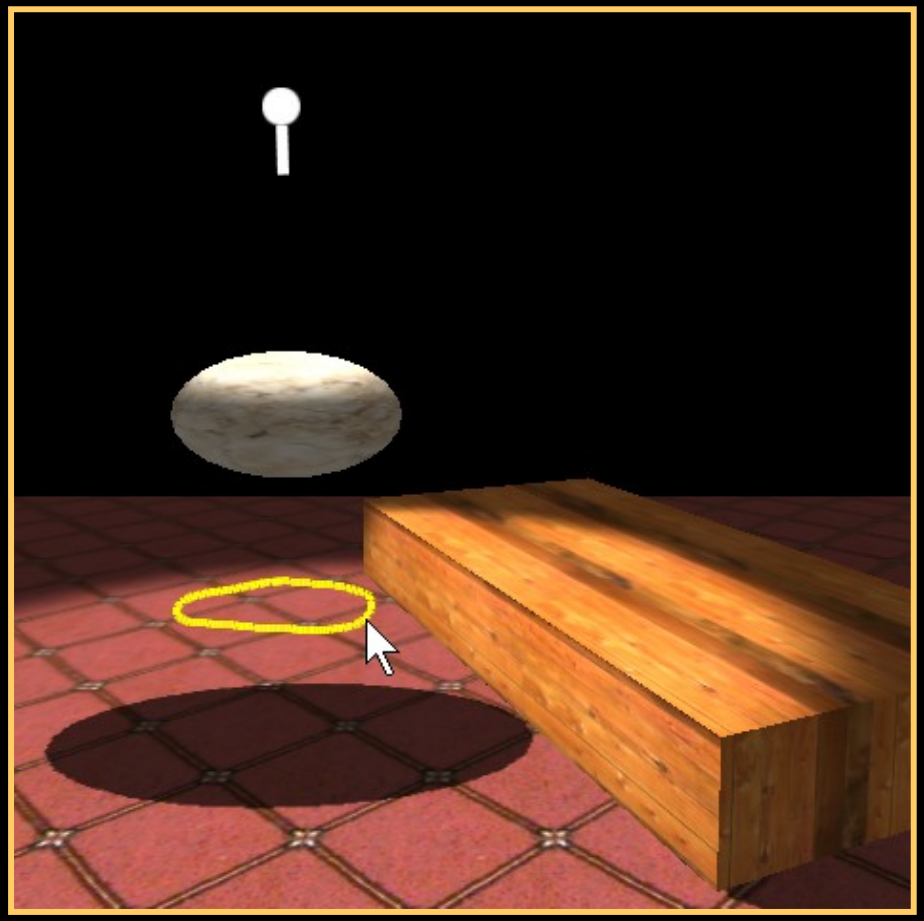
- Shadows are updated when constraints are valid

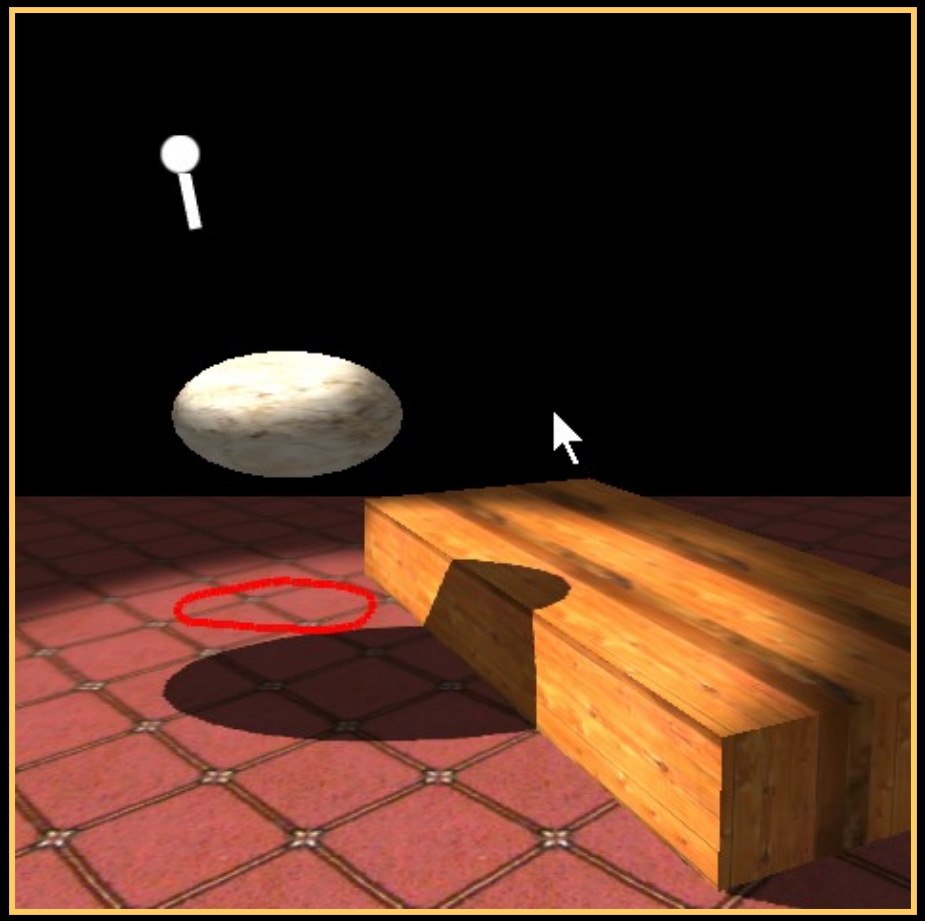




# Constraints

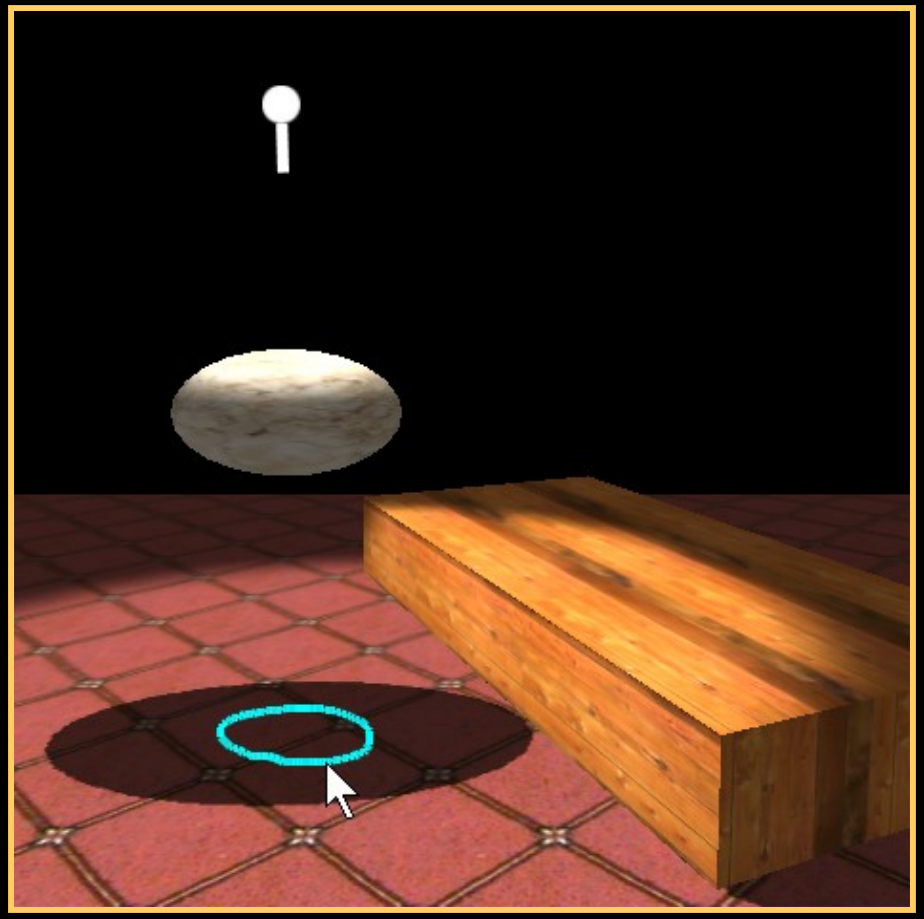
- User is informed when constraints are invalid

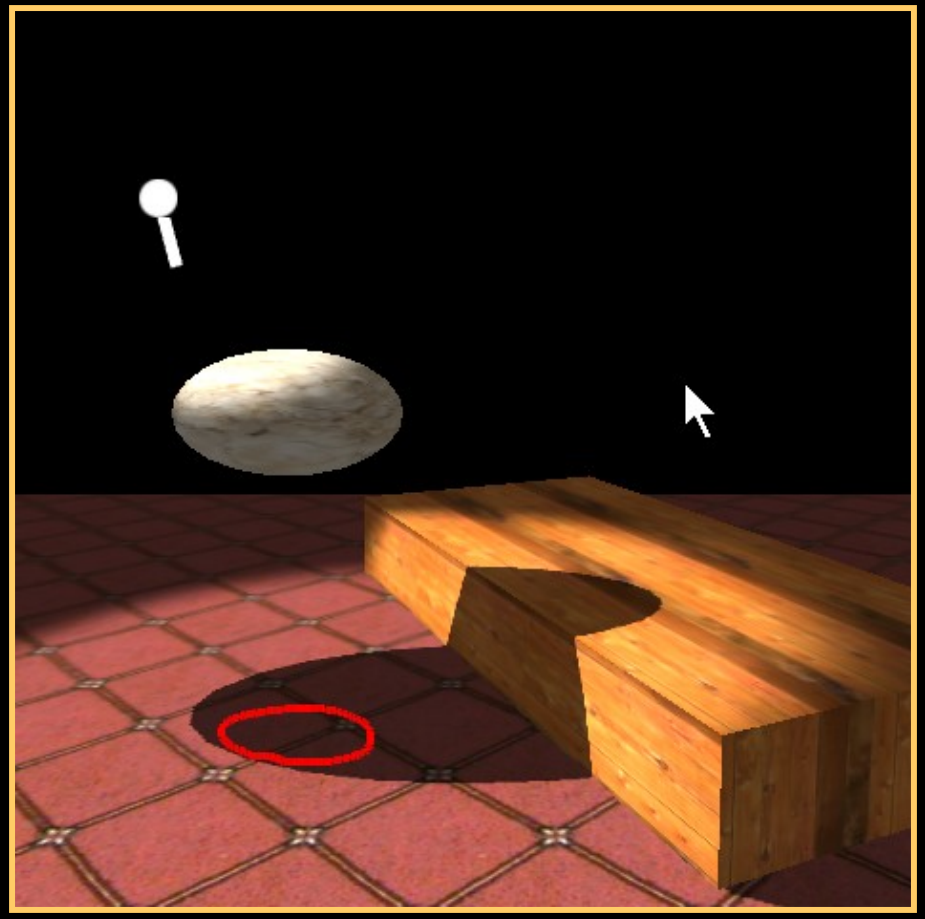




# Constraints

- Constraints for shadow regions

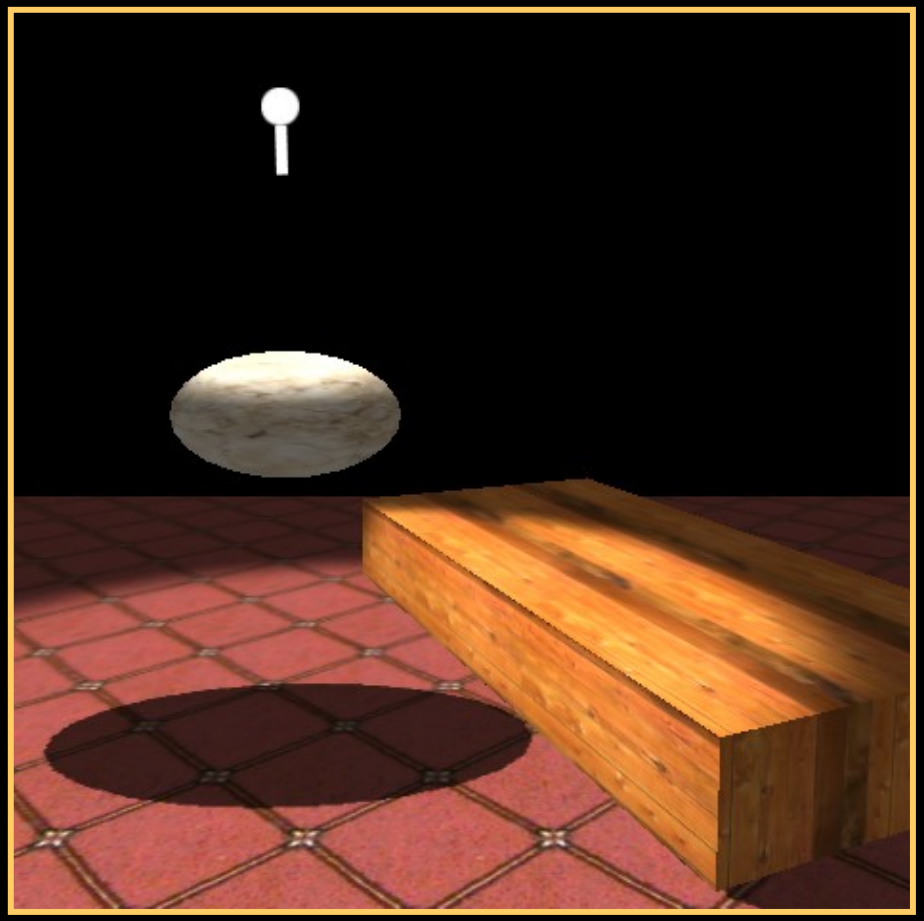




# Shadow/Light Cookies

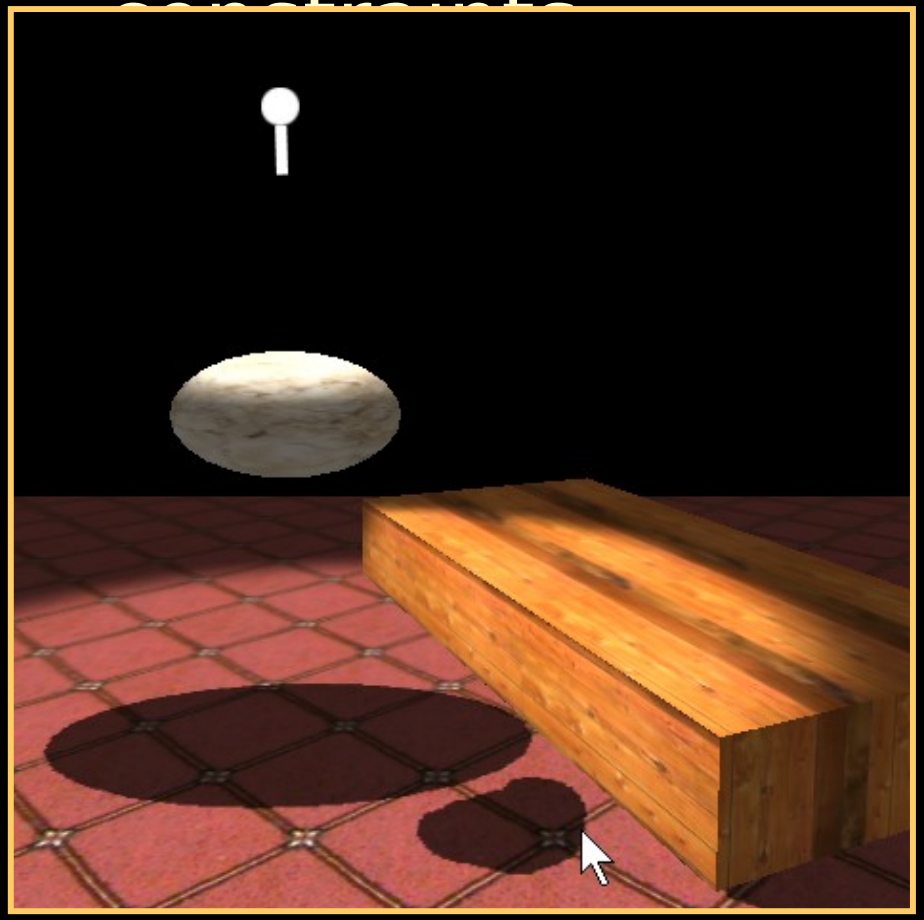
- Invisible “objects” used in cinematic lighting to add/remove shadows
  - Painting interface
  - First class objects

# Shadow Cookies

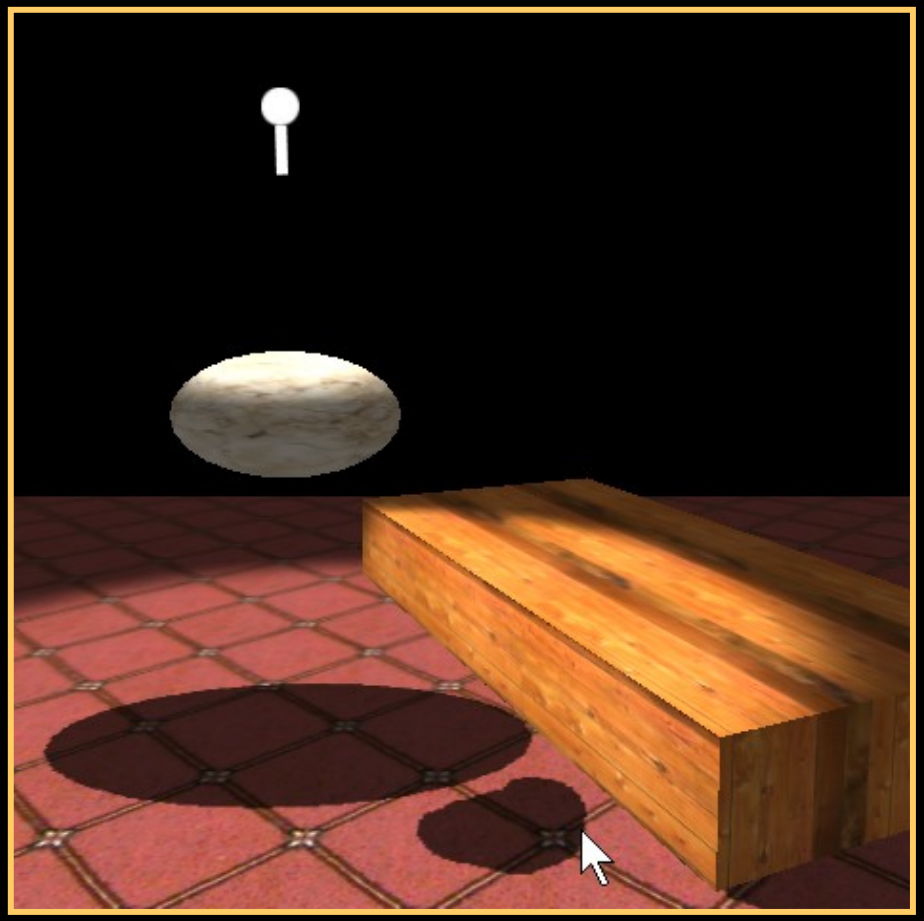


# Shadow Cookies

- Same painting interface used for constraints



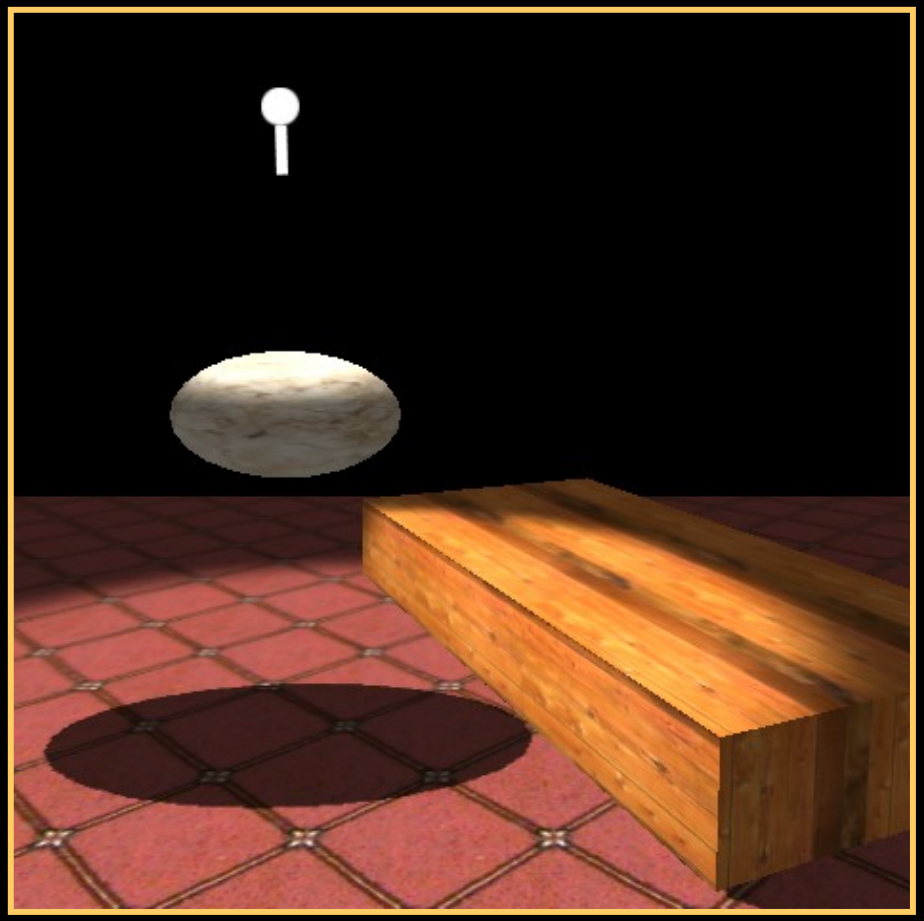
# Shadow Cookies



Attach to the light

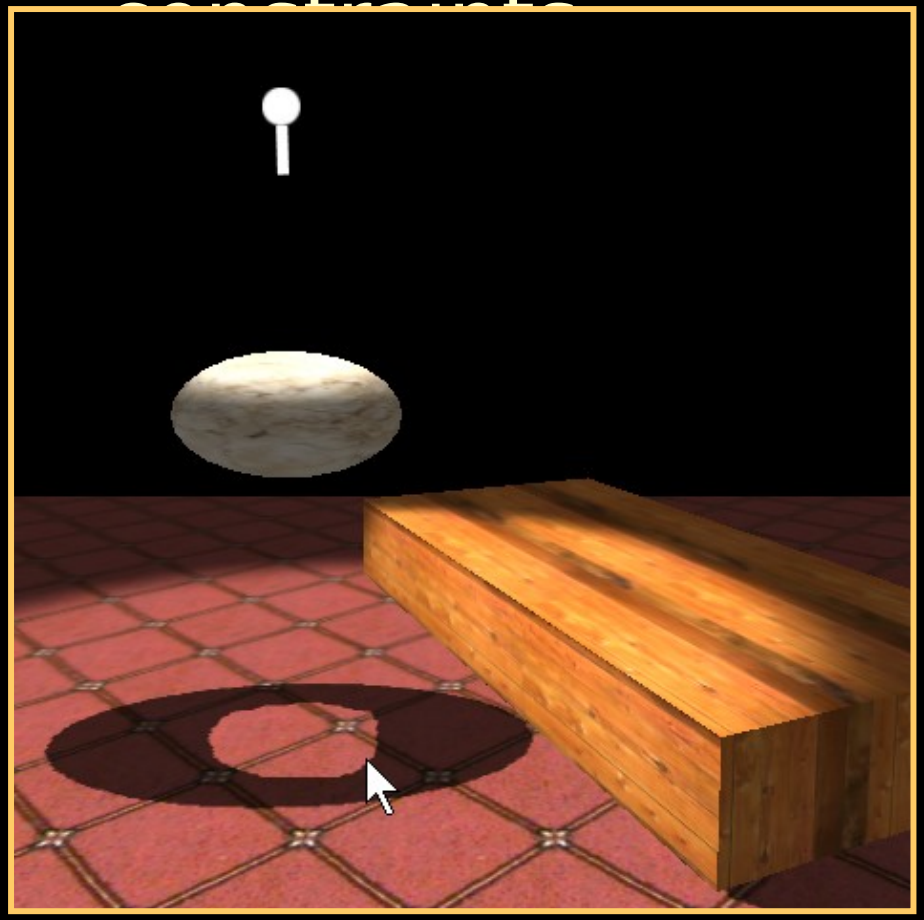
Attach to the world

# Light Cookies

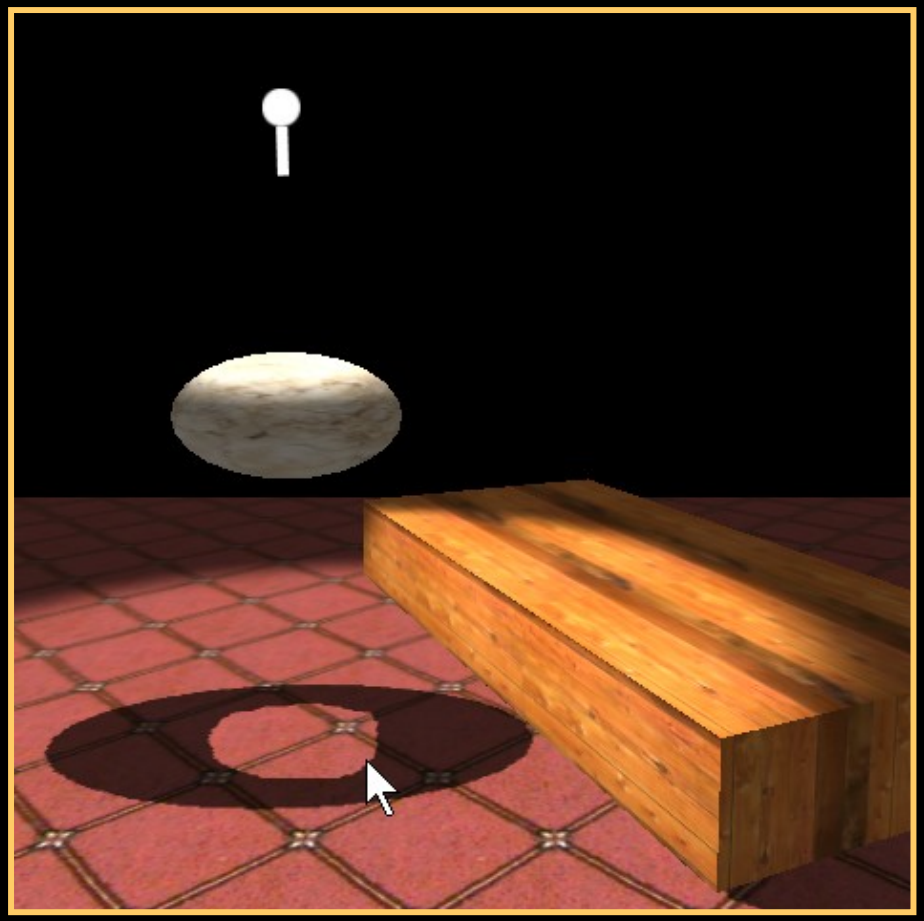


# Light Cookies

- Same painting interface used for constraints



# Light Cookies



Attach to the light

Attach to the world

# *Implementation details*

- Requirements
  - Interactive update of shadows
  - Interactive validation of constraints
- Rendering
  - Hardware-assisted shadow maps
  - Multi-pass algorithm for multiple lights
- Constraints validation
  - Constraints represented as array of 3d points
  - Read back data from hardware for validation

# Conclusion - VIDEO

# Conclusion

- Shadows as first class entities
  - Interactive feedback to the user
  - Shadow transformations same as object ones
- Intuitive constraints specification
  - Interactive constraint validation
  - Limit mouse interaction when necessary
- Shadow cookies as first class objects

# *Future work*

- Different input devices and UI metaphors
- Test scalability for complex environments
- More complex constraints
  - Already supported by the validation system
- Extensions to animated sequences
  - Supports only keyframing now

# Acknowledgements


- Thanks to Randy Fernando, James Ferwerda, Moreno Piccolotto and Bruce Walter for useful comments.
- This work was supported by the NSF Science and Technology Center for Computer Graphics and Scientific Visualization (ASC-8920219) and performed using equipment generously donated by Intel Corporation and NVidia Corporation.
- Modeling performed in 3DSMax. Models based on models from 3DSMax and 3DCafe.